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Research Article

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The Effect of Whey Protein (Natural Nanoparticle) on Muscle Strength, GH, IGF, T. Protein and body composition

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ABSTRACT

The aim of this study is to evaluate the effect of whey protein (natural nanoparticle) on muscle strength, GH, IGF1, T. Protein and body composition.
It is hypotheses that there is a significant difference of pre-post whey protein administration on muscle strength, GH, IGF1, T. protein and body composition for the sake of post administration compared to control method: the researcher used the experimental method of two groups, one experimental (n = 10) the other control (n = 10), using whey protein (20 g/day) for 12 weeks, the control group used placebo. The sample study was composed of twenty college Students of faculty of Physical education, Arish University.
Blood sample was withdrawn (10 ml) in a test tube for estimation of GH, IGF1, T1 protein, also the assessment of muscle strength of the upper and lower body, vertical jump tests together with body fat percent and body mass index, LBMY before and after whey protein and placebo administration.
The researcher reaches the following conclusion: whey protein administration for 12 weeks significantly increased IGF1, T. protein, GH. Also, an improvement of the muscle strength of the upper body and lower body vertical jump together with a decreased body mass index and body fat percent, LBM% increase in control group there was non-change in the assessed variables.
It is recommended to use whey protein in strength and competitive sports.

Keywords: *Whey protein, IGF1, T. protein, GH muscle strength and body composition*

INTRODUCTION

Nanoparticles are solid particles of a size of 10-100 mm. The term was introduced by a Japanese engineer (Norio Taniguchi). The term "Nano" was derived from the Greek word "dwarf", and one nanometer (nm) equal one billion of a meter, which is about 6 carbon atoms [1].

Nano particles are classified to two major groups, organic and inorganic group. The organic one is divided to: liposomes, fullerenes, carbon nanotubes and polymeric. While inorganic in further divided to: quantum dots, ceramic and magnetic [2].

Many nanoparticles occur as natural products such as whey's protein in human milk, lactose and Omega (3) (6) or may be engineered for application such as additives, nutritional supplements [3].

This research focuses on Nano sized particle which occur in nature, such as whey proteins as food supplement to explore its nutritional effect on the athletes.

Two factors cause nanoparticles to behave significantly than bulk ones [4].

1- Surface effects as nanoparticle have a large surface area that can interact with the environment, when a size is reduced this means the increased contact area [5].
2- Quantum effects, showing discontinuous behavior due to quantum effects in materials with delocalized electrons, as the morphology of Nano particles, size, shape and surface properties determine its characteristics. [6].

Whey protein contain natural nanoparticles which are effective in preserving muscle mass and increased muscle strength by stimulating protein synthesis and decrease protein breakdown, these are the two-cellular process essential to recovery and muscle hypertrophy. The ability of whey to stimulate muscle protein depend on the dose and composition of amino acids [7]. Also Lands et al [8] added that the amino acid cysteine is of importance for muscle performance, and the antioxidant found in the composition, of whey may enhance the decrease in some diseases and tumors [9].

Murray et al. [10] reported that insulin growth factor is not a pancreatic hormone but is related to insulin in structure and function. IGF_1 is single chain peptide of 70 amino acid. It has antigenic site and is regulated in a different way then insulin. As insulin is a very potent metabolic hormone, whereas IGF_1 is very potent in stimulating growth. Each hormone has a self-receptor. Each hormone correlates better with the affinity for binding to the receptor. They also added that. Protein determines colloidal osmotic pressure and form the plasma protein which is composed of many fractions, namely, albumin, globulins and fibrinogen, each fraction is related to specific function, as albumin affect osmotic pressure, globulin affect immunity and fibrinogen affect coagulation process, a decline in total protein means malnutrition and its elevation help increasing muscle mass and strength. Ganong [11] reported that there on interaction between growth hormone and IGF1, in inducing growth of muscle and other tissues.

Body composition measurement is an important part of the assessment procedure of the athletes, and excessive levels of body fat may be a cause of some cardiovascular diseases, cancer and other problems such as obesity and hyper glycemia [12, 13].

Muscle strength is a complex concept and is of important for the athletes to reach his target in different types of sports, it is affected by many factors:

1- Structural and anatomical factors.
2- Physiological and biochemical factors.
3- Psych neural / psychosocial factors.
4- External and environmental factors.

So, the muscular strength is the ability to exert musculoskeletal force against an external object such as a weight barbell, also the ground or an opponent or competitor [14].

Research problem

Nanotechnology is expected to be one of the leading science of the future. The decrease of the material from micro to Nano particle is beneficial to diverse scientific fields and has to potential to revolutionize physical field and medical diagnosis and care[15, 16].

The use of whey protein as a natural milk product of Nano size is beneficial to the athletes, as its small size and scale, allow its protein to be digested very rapidly and absorbed from the stomach and duodenum and hence to he used by the muscle more rapidly than any protein and help to be a natural ergogenic agent without any side effect.

The research problem depends mainly in using a new technology to help in increasing muscle mass, strength together with decreasing fat mass an percent and increasing lean body mass, this in turn will help in improving athletic performance which is the main target of any athlete to reach a top form.

The aim of thin study is to evaluate the effect of whey protein administration on muscle strength IGF_1, T. protein, GH and body composition.

Research hypothesis:

It is hypothesized that there is a significant difference of pre-post whey protein administration on muscle strength GH, IGF_1 T. protein and body composition for the sake of post administration.

RESEARCH METHOD

The researcher used the experimental method as it is suitable to the nature of the study of pre-post measurement of two groups, one experimental group administered whey protein (20 grams/day) for 12 weeks and the control group administered placebo for 12 weeks.

The pre-measurement was executed in 1/4/2017 blood sample was withdrawn for analysis of GH, IGF1 and total protein, also body fat percent and body mass index, LBM muscular strength assessment of the upper and lower body tests for bench press strength in 1 RM/body weight and seated leg press in 1RM/body weight in pounds, vertical jump the same procedures were done after 12 weeks administration of whey protein and placebo in 23/6/2017.

Research sample: Twenty college students were the participants of This study, of Arish university, they were randomly selected to participate to the study and each write a consent note of participation to the study and the experiment was conducted following the guidelines and ethical rules of the physical education faculty, and the university.

Table 1. Basic characteristics of the players.

Variables	Mean	SD	Skewness
Age (y.)	23.4	3.4	0.37
Height (cm)	174.3	8.3	-0.26
Weight (kg)	73.9	7.1	-0.19

In table (1) skewness were between (-0.19 and +0.39) which is laying between (±3) indicating natural distribution of the athletes.

Measurements of the study:

- GH, IGF_1 were measured using Elisa technique and kits.
- Total protein was measured using spectrophotometer and kits.
- Muscular strength assessment of the upper body test and lower body test for bench press strength in 1RM/body weight and seated leg press in 1RM/Body weight in pounds, the values for bench press strength and seated leg press were rating for each participant as (poor, fair, average, good or excellent for the age) using the method mentioned by Hatfield [17]
- Also, body fat percent and body mass index were measured for participants before and after the administration of whey protein and placebo.

Strength assessment of upper a lower body test calculation of (1RM) one repetition maximum, the athlete body weight multiplied by the minimum value listed in the table (age group) heading to give idea of the weight to start with when testing for (IRM). Weight or athlete in Lbs. X rating group – est. (IRM) and compare with the chart to have rating [17].

Materials and equipment used

- Restameter for height.
- Digital weight for weight.
- Syringes and tubes, alcohol, cotton, plasters.
- Centriguge.
- Elisa technique + kits for hormonal analysis.
- Spectrophotometer + kits for T. protein.
- Ice box, refrigerator.
- Body mass index, relative weight for height.
- Body fat percent using skin fold thickness converted to fat percentage (triceps, subscapular, pectoral, abdominal, suprailliac, quadriceps and calf.).
- Tanita apparatus for lean body mass (LBM).
- Vertical jump, by jumping as high as possible, touching the board twice at the height of the jump.
- The test score is the best trial score, and the jump begins by a preparatory position, which is a squat position with the feet still flat on the floor.

Statistical analysis

The obtained data were analyzed using the statistical package for social science (SPSS) for obtaining mean and standard deviation. The data were analyzed using one-way analysis of variance to determine the significance of differences among groups. Skewness was also obtained. The values were significant at $P \leq 0.05$ for statistical analyses.

RESULTS

Table (2) represent muscle strength assessment, before and after whey protein and placebo administration, the control group did not change in all variables. The experimental one indicated that the whey administration led to a significant increased vertical jump, upper and lower body values. As for table (3) the whey protein administration led to significant increased IGF1, GH, T. protein concentration, while no changes occur in case of the control group. In case of table (4) the whey protein administration led to a significant decreased body fat%, BMI and an increased LBM%. While in case of the control group there were non-significant changes in all parameters.

Table 2. represent muscle strength assessment of upper body IRM/BW (bench press) and seated leg press for lower body (1RM/BW), vertical jump, before and after whey and placebo administration, and vertical jump.

Variables	Control				Experimental				Sig.
	Before		After		Before		After		
	M	SD	M	SD	M	SD	M	SD	
Vertical jump (cm)	37.3	3.2	37.9	3.7	37.4	37.1	40.5	2.9	S
Upper body bench press values	0.97	0.12	0.99	0.13	0.98	0.11	1.19	0.14	S
Seated leg press values	1.87	0.15	1.90	0.16	1.89	0.14	2.1	0.17	S

Rating control before was average and after did not change (before and after placebo) in bench press strength 1 RM/B. W and in seated leg press.

Rating experiment was average before administration of whey protein and improved to good rating after the administration in upper body test and seated leg press (1 RM/B. W) $P < 0.05$.

Table 3. IGF_1, T. protein concentration, GH in experimental and control group before and after whey and placebo administration.

Variables	Control				Experimental				Sig.
	Before		After		Before		After		
	M	SD	M	SD	M	SD	M	SD	
IGF_1 (ng/ml)	25.7	3.6	27.3	4.2	26.3	3.2	38.9	4.5*	S
GH (ng/ml)	5.2	1.3	5.3	1.4	5.5	1.2	6.2	1.1*	S
T. protein (g/dl)	6.2	1.1	6.4	1.3	6.3	1.0	7.6	1.5	S

Table (3) IGF1 and T. protein concentrations, GH increased significantly after, whey protein administration while no change occur in case of the control group $P < 0.05$.

Table 4. indicating the effect of whey protein and placebo in the experimental and control groups before and after the administrations.

Variables	Control				Experimental				Sig.
	Before		After		Before		After		
	M	SD	M	SD	M	SD	M	SD	
Body fat %	18.3	2.4	17.7	3.1	18.1	2.6	16.7	2.3*	S
BMI	23.4	3.5	23.1	3.3	23.7	2.9	20.6	2.2*	S
LBM%	81.7	7.3	81.6	6.8	81.9	6.2	83.3	6.1*	S

Table (4) represent body fat % and BMI, LBM% of both groups before and after whey protein and placebo administration, the results indicated that whey protein decreased fat percent and BMI significantly LBM increased while no changes occur in case of control group $P < 0.05$.

DISCUSSION

Table (2) revealed a significant increase in muscular strength assessment of the upper body test and lower body test for bench press strength in 1RM/body weight and seated leg press in 1 RM/body weight in pounds, and vertical jump, after whey protein supplementation for 12 weeks compared with the control group. The ex0perimental muscular strength was changed from rating average to good while the control group did not change from average

after the administration of whey protein and placebo for 12 weeks. Also, the vertical jump test significantly increased in experimental group.

This indicate that the whey protein increased muscular mass and strength which affect the performance of the experimental group due to increasing muscle building and limiting muscle loss, also increasing the energy yield and metabolism, this result is in accordance with the results of the researchers [9, 18,17].

Table (3) revealed an elevated GH, insulin-like growth factor 1 (IGF-1) significantly after the administration of the natural Nano particle whey protein for 12 months compared to control group using placebo.

The increased GH, IGF_1 indicated an increased muscle growth, also muscle mass and muscle strength, as GH, IGF_1 increase protein metabolism and protein synthesis of the skeletal muscle, also stimulate motor neuron regeneration as GH, IGF_1 are a potent neurotrophic factor for motor, also they help to maintain high levels of choline acetyl transferase activity, GH, IGF1 as a potent myogenic factor, promoting muscle growth and hypertrophy together with myofiber growth, as IGF_1 and GH act as myogenic and neurogenic factor, this result is in line with the results of : Rabinousky et al. [19, 20, 21, 22].

Table (3) revealed that T. protein concentration increased significantly after whey protein administration in experimental group compared to the control group the increased T. protein was within physiological concentration and indicated on anabolic effect of whey protein affecting the muscle mass of the experimental group compared to the control one.

This elevated protein concentration was in line of the researchers [10, 23, 24, 25] that the concentration of protein determines colloidal osmotic pressure of the blood and the concentration of protein in plasma is influenced by many factors including, the nutritional state liver function and kidney function and the case of the person in health and disease and the variation of the plasma protein may signify disease, also of importance that the increased total protein may signify an anabolic effect which in turn indicated the impact on skeletal muscle including increase in skeletal muscle mass and increased muscle strength and athletic performance. That means that the improvement of the strength tests of the upper and lower boy was a direct effect of the whey ingestion and its assimilation in muscle metabolism leading to this positive effect.

[26] reported that whey protein is composed of different amino acids together with dipeptides and albumin and lactoferrin that simulate growth, growth hormone, IGF, and increase muscle mass, also it is an important supplement for immunity and increase glutathione and neutrophil and cytokines, and help to decrease the action of bacteria and prevent some disease from spreading and help t improve viral diseases such as AIDS and HIV together with its important improvement of muscular strength and muscular mass and functions due to its components of protein and its function to stimulate growth promoting factors. This was also reported by some researchers: Farouk Abdel Wahab [27], 28 Hussein Heshmat [28], EsamNour El Din [29], Heshmat, Mohamed [30].

Researchers indicated different effects of the whey protein on increasing amino acids, which in turn increased protein synthesis and muscle mass increase, together with a change in body composition, such as fat percent decrease and increasing building muscle and limiting muscle loss [31]. Also, whey protein play an important role in energy metabolism, as the high calcium level incorporated with the dairy milk protein decreased fat gain and increase fat metabolism and accelerate body fat loss [32, 33].

As for the relation of whey protein and digestive system and satiety, [34] reported that whey protein has a depressant effect on appetite and satiety center, so as to decrease food whey protein stimulate some hormones that affect digestive system leading to decrease food intake such as cholecystokinin hormone.

Table (4) revealed a significant decrease in body fat percent and body mass index increase LBM in case of the experimental group after whey protein supplementation (20 grams/day) for 12 weeks compared with the control group after placebo administration for 12 weeks, these results indicated the positive effect of whey protein in its action on body fat% and BMI, LBM as these effects were reached without the stimulus of exercise training, indicating also that whey protein may be used in cases of overweight and obese cases, and provide better improvements in body composition, it may be also concluded that whey protein enhance metabolism and basal metabolic rate which may help to retard the negative effect of exercise inducing fatigue and hence an improved performance, this is in accordance with the researchers [35, 36, 37, 38].

Data presented in Tables (2, 3, 4) indicated that the natural Nano particle whey protein administration increased significantly the growth hormone (GH), the body composition lean body mass % (LBM) and the vertical jump (VJ) compared with the placebo administered group (control). These results mean that the whey rich protein is an important ergogenic material for elevation of muscle mass and strength and decrease body fat.

This is in accordance with Song et al [39, 40], they reported that biologically athletes using natural products may have greater body muscle mass than those not using any supplement or don't eat balanced food. This is true as balanced diet and suitable ergogenic nutrition might induce anabolic function and help to improve performance of young male subjects.

[41] reported that amino acids (one of Nano particles of whey proteins) and also the dipeptides are absorbed rapidly from the duodenum and proximal jejunum and carried to the liver by portal blood, the absorption is carried by a sodium carrier and form a complex substance with the help of ATPase, this rapid absorption of Nano particles is very important for the sake of the athletes and improve many mechanisms leading at the end of the improvement of the athletic performance, this means that the integrated anabolic protein of the whey due to its natural nanoparticle induce a series of events leading to rapidly ignite protein synthesis and lean muscle growth and influence the development of new lean body mass.

The natural nanoparticles of whey amino acids and dipeptide induce the following:

- It dramatically increased protein synthesis which is the main stone of muscle building.
- It significantly increases recovery ability that help to return early to exercise.
- It increases GH and IGF1 significantly, these hormones are majors in muscle growth and strength.
- It decreased muscle breakdown, that help to renew muscle rapidly.
- It increased muscle energetic and power which help performance.
- It increases the bioavailable protein per gram than any protein as whey contain protein of high biological value.
- It contains high level of powerful dipeptides known to be rapid absorbed and metabolized and optimal digestibility.
- It increased nitrogen retention and increased IGF, GH released together with protein.
- It contains branched chain Amino acids (BCAAs) for accelerating anti-catabolic response.
- It contains high level of glutamine which act as growth factor helping in protein and muscle synthesis the preceded discussion indicated that the hypothesis of the research "there are a significant difference of pre-post whey protein administration on muscle strength, GH, growth factor IGF, and body composition for the sake of post administration has been realized.

CONCLUSION

Whey protein administration for 12 weeks significantly increased IGF_1, T. protein, GH also an improvement of the muscle strength of the upper body and lower body, vertical jumps together with a decreased body mass index and body fat percent, LBM increased, while control group there was no change in the assessed variables. It is recommended to use whey protein in strength and competitive sports.

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